Group 4 - The Quest

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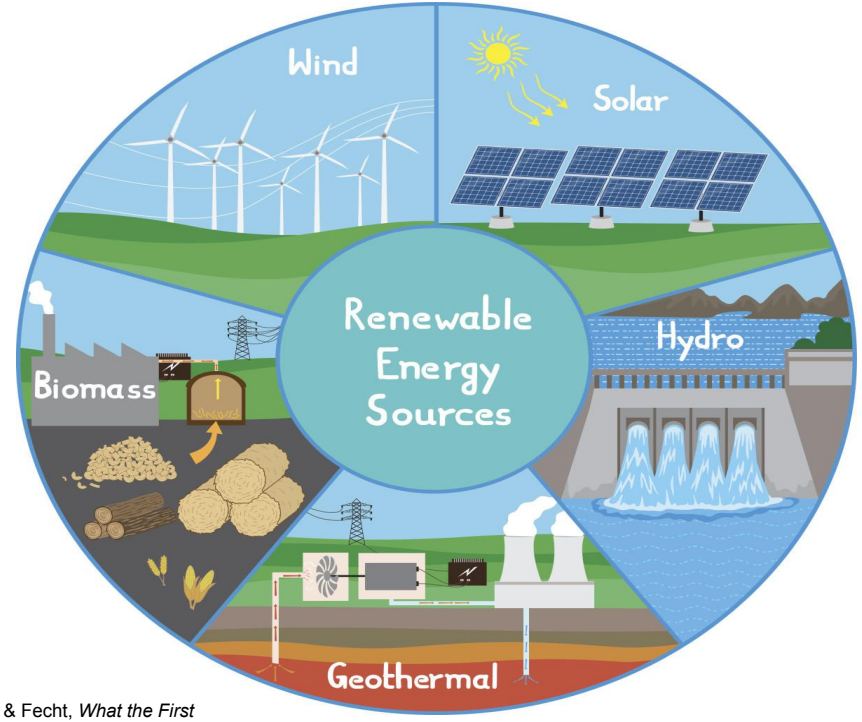
Chapter 27 & 28

Rebirth Of Renewables
Science Experiment

WHAT DOES "RENEWABLES" MEAN TO THIS WORLD ?

Renewable Energy has become a great source of energy across the globe for its eco friendly nature and providing ample amount of energy resources and storage at cost efficient manner. The following are good examples of Renewable Energy :-

- Wind Energy
- Solar Energy
- Biofuels- Made from algae, cellulose and other feedstocks.
- Hydro Energy
- Biomass- Burning of Plant based or Wood
- Geothermal



(21 & Fecht, *What the First Earth Day achieved* 2020)

REBIRTH OF RENEWABLES

The rebirth of Renewables shows the importance of how the United States Of America made a public announcement regarding the value of clean and green energy sources. On June 20th 1979, President Carter and the First Lady went to the roof of The White House and they said that “There is no embargo on Sun.” He also said that the $28,000 investment they have made is going to help them save money on electricity for another 7-10 years and he said this is the best way to enable the country to move forward towards green energy and wants to promote the usage of green energy in the country.

(Murdock, *The strange, tumultuous life of solar power at the White House* 2022) Murdock, A. (2022, March 14). *The strange, tumultuous life of solar power at the White House*. University of California. Retrieved February 16, 2023, from https://www.universityofcalifornia.edu/news/strange-tumultuous-life-solar-power-white-house

THE IMPORTANCE OF EARTH DAY

On April 22, 1970 - Earth Day crystallized a new environmental consciousness in America and established its political potency. The Earth Day was basically created to develop National consciousness about the environment in America. Denis Hayes, a graduate student at Harvard's Kennedy School Of Government, was reported that he took off to create Earth Day. This mission became so successful that from coast-to-coast people aimed towards the national consciousness. It was reported that 20 Million Americans joined towards this movement. Later this became an international movement.


The New York Times

NEW YORK, THURSDAY, APRIL 23, 1970

Ilions Join Earth Day Observances Across the Natio

Jamming Fifth Avenue yesterday in response to a call for the regeneration of a polluted environment. View is north from 42d Street, with Central Park in background

NCERN SUED 2 IN JAPAN

Mood Is Joyful as City Gives Its Support

By JOSEPH LELYVELD

Activity Ranges From Oratory to Legislation

By GLADWIN HILL

BACKERS OF ROJAS THREATEN REVOLT

But Colombian Government Appears in Full Control—

U.S. Plane Flies In Arm As Trinidad Fights Mutir

By TAD SZULC

WASHINGTON, April 22—The United States flies

(21 & Fecht, *What the First Earth Day achieved* 2020)

THE MORAL WAR AND FORMATION OF DEPARTMENT OF ENERGY

- President Carter's administration worry towards the oil crisis and their focus towards strengthening the natural energy resources like coal and energy conservation as principal backups.

- Due to the CIA reports of Oil supply decline within a decade in 1977 he immediately addressed the nation after his inauguration that his main agenda is creating a solid energy policy. He always spoke about war that can be caused due to the scarce supply of oil and gas.

- President Carter teams up James Schlesinger, former director of central intelligence with secretary of defense under Nixon and Ford to come up with an energy policy in 90-days program

U.S. DEPARTMENT OF ENERGY

James Schlesinger a master in bureaucracy combined 50 different agencies dealing with energy into one big department and that is the DOE.

(Energy, *U.S. Department of Energy Office of Legacy Management Marks its 100th site* 2019)Energy, U. S. D. of. (2019, October 15). *U.S. Department of Energy Office of Legacy Management Marks its 100th site*. U.S. Department of Energy Office of Legacy Management Marks Its 100th Site. Retrieved February 16, 2023, from https://www.prnewswire.com/news-releases/us-department-of-energy-office-of-legacy-management-marks-its-100th-site-300938619.html

https://www.youtube.com/watch?v=EJyBeU-5jt8

THE PURPA MACHINE

What is PURPA?

PURPA (Public Utility Regulatory Policies Act Of 1978). In this policy cited:Section 210 is considered to be one of the main foundation for the birth of renewable industry. In this policy there was something called Qualifying Facilities where these facilities were mostly cogeneration projects or small scaled renewable facilities where they had to build small dams or wind turbines. This was a calculated move where the rate of these utilities would pay the owner of the QF depending on state based on the “avoided cost”. The avoided cost is the cost of theoretical prices of oil and gas in the future plus the cost of creating new power plants.

(*One of the nation's largest electric distribution cooperatives located in Central Florida*) *One of the nation's largest electric distribution cooperatives located in Central Florida*. SECO Energy. (n.d.). Retrieved February 16, 2023, from https://secoenergy.com/purpa/

https://www.youtube.com/watch?v=RBAaaCtwYbE

THE 3 P'S

The 3 P's are nothing else but Production, Production and Production. President Carter was believed to be Energy pessimist. He always thought about the great dangers that the country can face and create an environment of caution. Whereas the Reagan administration was known as the sunny optimist, a government with self confidence. The Reagan administration left the market principles shape the energy sector. Carter administration was in complete chaos in the energy sector due to corruption and political reasons. The Reagan administration took swift transition roles to the 3 P's model start domestic production of oil and gas. They did bring a lot of changes compared to the reagan administration.

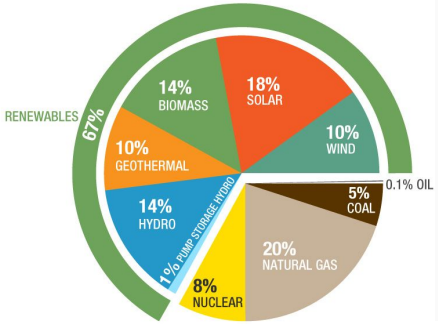
(*Domestic policy of the Ronald Reagan Administration* 2022) Wikimedia Foundation. (2022, October 26). *Domestic policy of the Ronald Reagan Administration*. Wikipedia. Retrieved February 16, 2023, from https://en.wikipedia.org/wiki/Domestic_policy_of_the_Ronald_Reagan_administration

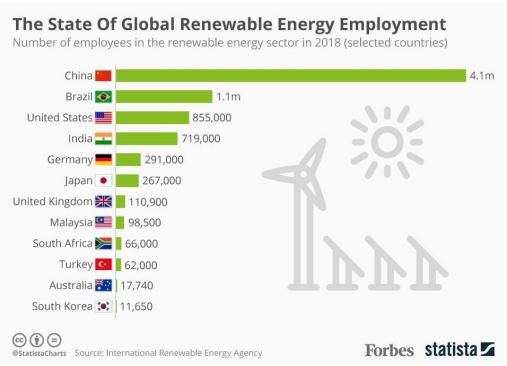
(*Reagan's energy plan: Paper promises* 1981) The New York Times. (1981, August 2). *Reagan's energy plan: Paper promises*. The New York Times. Retrieved February 16, 2023, from https://www.nytimes.com/1981/08/02/business/economic-affairs-reagan-s-energy-plan-paper-promises.html

COUNTRIES AND THEIR DRIVE TOWARDS GREEN ENERGY

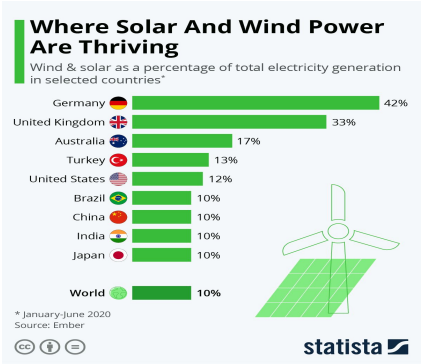
In the quest the three major countries the talk about is the USA, Japan, Germany and China. In all four cases we can see a common point where countries feared the scarcity of oil and gas and shifted their complete focus and creating large and substantial policies for energy infrastructure in their respective countries. The countries clearly specify the oil crisis they underwent in the early and late 1970's and what were the measures they took. In case of Japan their MITI minister wrote a novel to explain the situation and in China they took steps in 1973 where they slow started the wind and solar projects and by 1988 they had a full fledge solar and wind farm. In 2005 and 2007 China made long term policies for renewable energy industries.

Shift to renewable energy by 2050 as proposed by the Institute for Sustainable Energy Policies





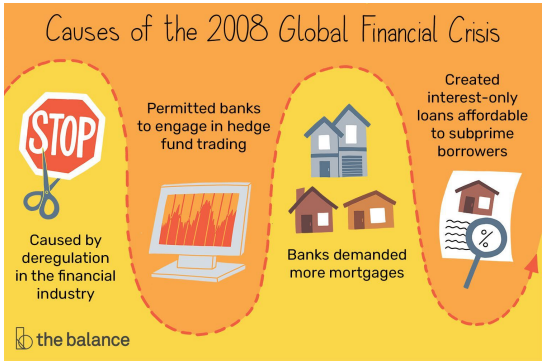
UNUniversity. (n.d.). *Can Japan go 100% renewable by 2050?* Our World. Retrieved February 16, 2023, from https://ourworld.unu.edu/en/can-japan-go-100-renewable-by-2050



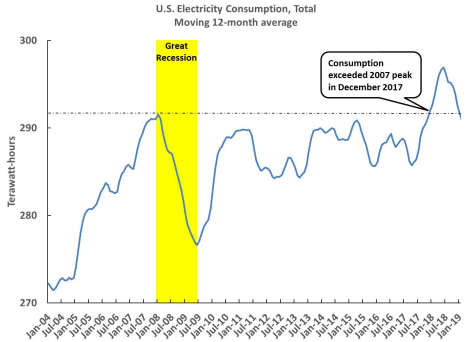
McCarthy, N., & Richter, F. (2020, August 13). *Infographic: Where solar & wind power are thriving*. Statista Infographics. Retrieved February 16, 2023, from https://www.statista.com/chart/22258/wind-and-solar-generation-in-selected-countries/

CLEAN TECH

- The rising prices for the energy sector started around 2003 and 2004.
- During this time the growth of renewable sector was pacing high in a steady form.
- The 2008 economic recession or the Great recession hit the industry hard. Even with the subsequent rebound in the rates from the late 2008 the industry was still facing the disadvantage.
- The situation was not like the 1980's since the renewable energy had strong legislations and far reach across the country.



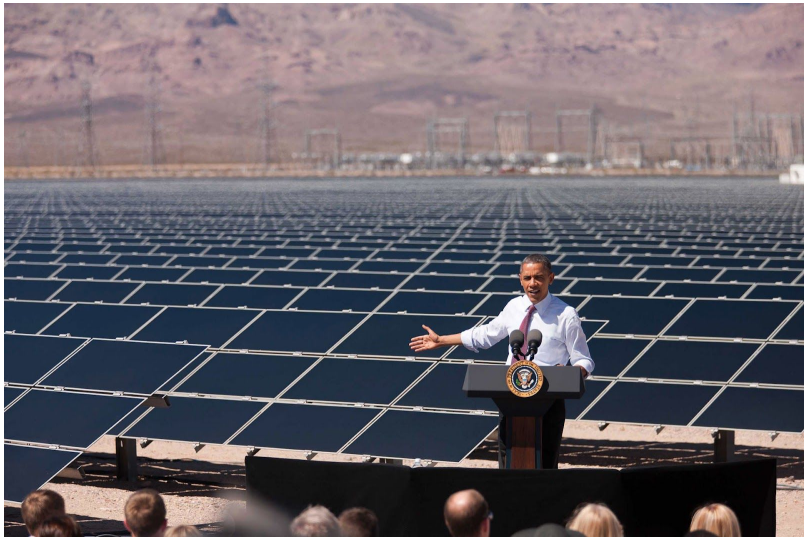
Amadeo, K. (n.d.). *Causes of the 2008 financial crisis*. The Balance. Retrieved February 16, 2023, from https://www.thebalancemoney.com/what-caused-2008-global-financial-crisis-3306176



Wilson, J. (2021, May 13). *The great recession and the U.S. Power Market: Implications for the Covid recession*. Energy Central. Retrieved February 16, 2023, from https://energycentral.com/c/ec/great-recession-and-us-power-market-implications-covid-recession

USA AND ITS PERSPECTIVE OVER THE YEARS ON GREEN ENERGY "NO AREA MORE RIPE"

- President Obama and his administration pushed the renewable energy to be the top priority for energy resource in the country.
- The government reserved funds for renewables and cleantech even during the economic crisis.
- Jobs in cleantech and renewables boosted the stimulus package.
- The largest energy bill was passed.
- In his speech at Congress during the 2010 State of The Union Address he said, " No area's more ripe for such innovation than energy.
- Renewable energy global investment reached $150 billion in 2009.
- He re-installed solar panels for water heater in 2010 which was removed in 1986.



President Obama's renewable energy legacy. Environment America. (2022, August 6). Retrieved February 16, 2023, from https://environmentamerica.org/articles/president-obamas-renewable-energy-legacy/

https://environmentamerica.org/articles/president-obamas-renewable-energy-legacy/

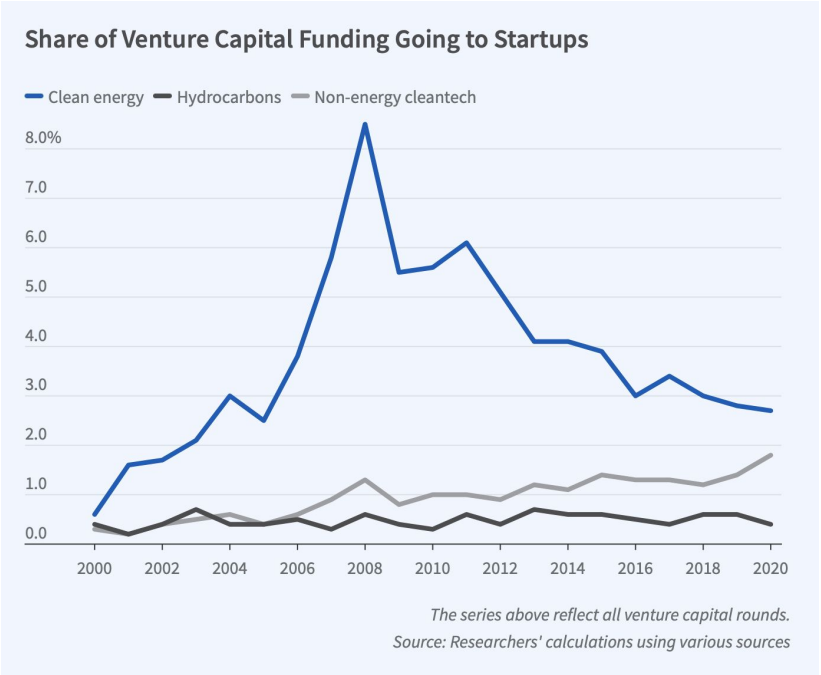
EXPERIMENTS OVER THE YEARS

- Over the years a lot of experiments have occurred across the country regarding renewables and a lot of these are conducted by public and private universities in The United States.
- These breakthrough technologies is what caught the eye of venture capitalists to create new diversified portfolio for themselves in the market. Heavy investments have been pumped in from VC's along with the government to create new patents and industries.

Determinants of venture capital investment in Clean Energy. NBER. (n.d.). Retrieved February 16, 2023, from https://www.nber.org/be/20222/determinants-venture-capital-investment-clean-energy

THE ROLE OF VENTURE CAPITALISTS IN ENERGY SECTOR

- Over the years due to increased traffic in fresh new graduates across the country working and developing new experiments has caught the eye of venture capitalists.
- We now have new facilities and hear new names in the sector other than the age old Bell Labs, GE, Westinghouse and RCA. More funding gives more open area for R&D. VC's are smart investors as they do thorough analysis about the product and its founder along with market growth and strategy.

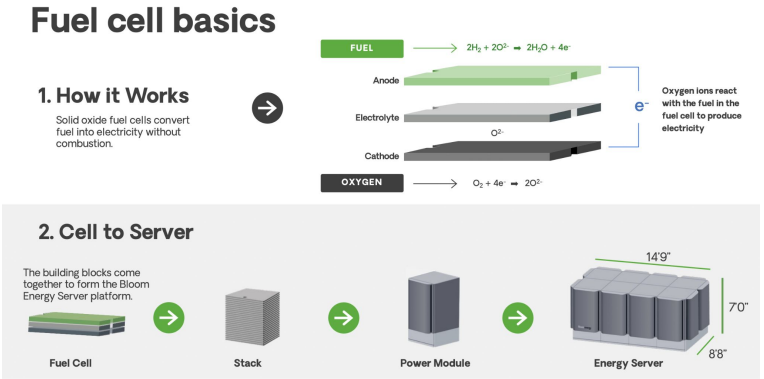


Determinants of venture capital investment in Clean Energy. NBER. (n.d.). Retrieved February 16, 2023, from https://www.nber.org/be/20222/determinants-venture-capital-investment-clean-energy

THE BIRTH OF STARTUPS

Bloomenergy®

Energy, B. (2018, July 27). *Bloom Energy Files Registration Statement for proposed Initial Public Offering*. Bloom Energy Files Registration Statement for Proposed Initial Public Offering. Retrieved February 16, 2023, from https://www.prnewswire.com/news-releases/bloom-energy-files-registration-statement-for-proposed-initial-public-offering-300665168.html



5, M. E. J., & Evans, M. (2022, July 7). *Bloom Energy revs up natural gas, hydrogen in Europe with Ferrari behind the wheel*. Natural Gas Intelligence. Retrieved February 16, 2023, from https://www.naturalgasintel.com/bloom-energy-revs-up-natural-gas-hydrogen-in-europe-with-ferrari-behind-the-wheel/

https://www.youtube.com/watch?v=T0TBwCVKzZQ

REBIRTH OF RENEWABLES

Definitely we can conclude from all the above resources and points that strating from early and late 70’s to now we have seen the renewable energy grow in large scale and receive a great amount of respect from the government sectors as well as private. We hope that by 2030 all countries should have reached a good percentage or procuring energy from renewables.

Google. (n.d.). *GO GREEN* . Google. Retrieved February 16, 2023, from https://www.google.fr/webhp?sourceid%3Dchrome-instant%26ion%3D1%26espv%3D2%26ie%3DUTF-8

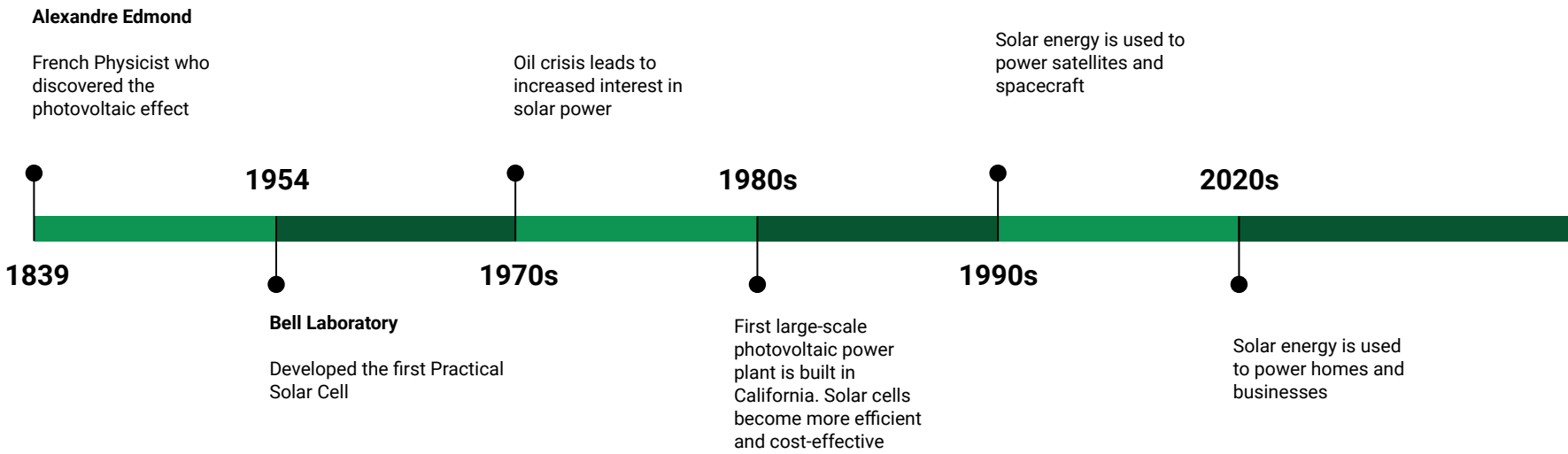
Chapter 29

Alchemy of Shining Light

Introduction

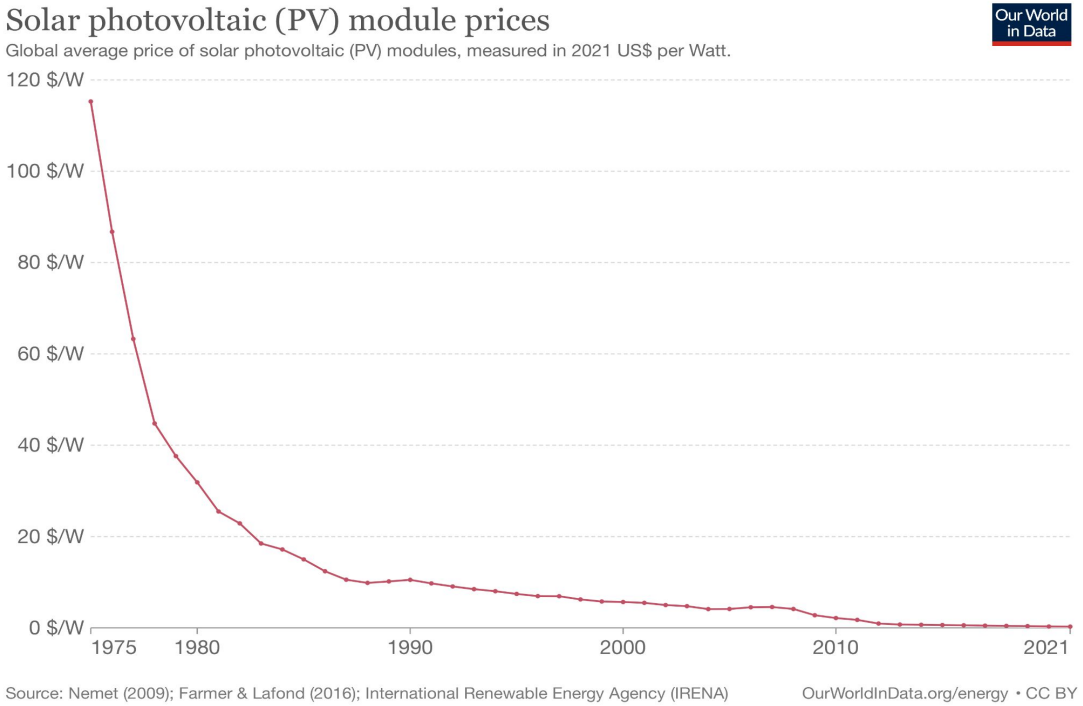
This Chapter explores the history and future of solar power, from its development in the 19th century to its impressive growth in recent years. It examines the challenges facing solar power, its potential impact on the global energy landscape, and the potential for further advances in the future.

History of Solar Power

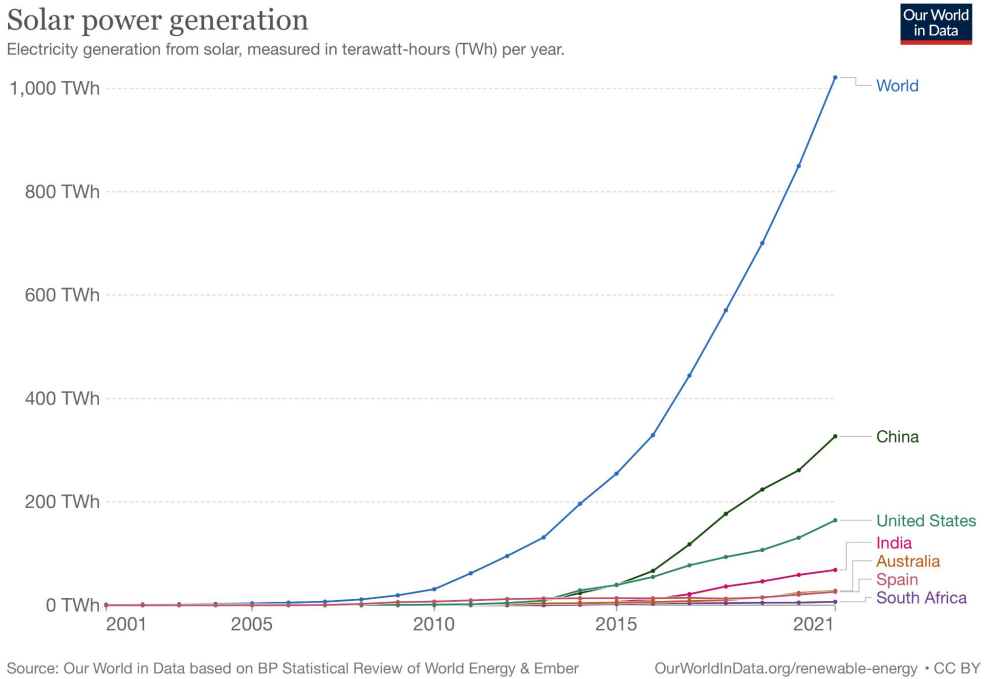


Growth of Solar Power

- Much of the growth of solar power to the rapid decline in the cost of photovoltaic (PV) solar panels, which has fallen by 99% since 1976.



- Global installed capacity of solar power has increased from just 1.5 gigawatts (GW) in 2000 to over 700 GW in 2020.
- In China, the government's ambitious targets for solar power deployment, coupled with strong support for domestic solar manufacturers, have helped to drive the rapid expansion of the country's solar industry.



Challenges facing Solar Power

- Necessity of energy storage solutions.
- Competition from other sources of energy, such as natural gas and wind power.
- The Cost

Chapter 30

Mystery of Wind

Wind Power

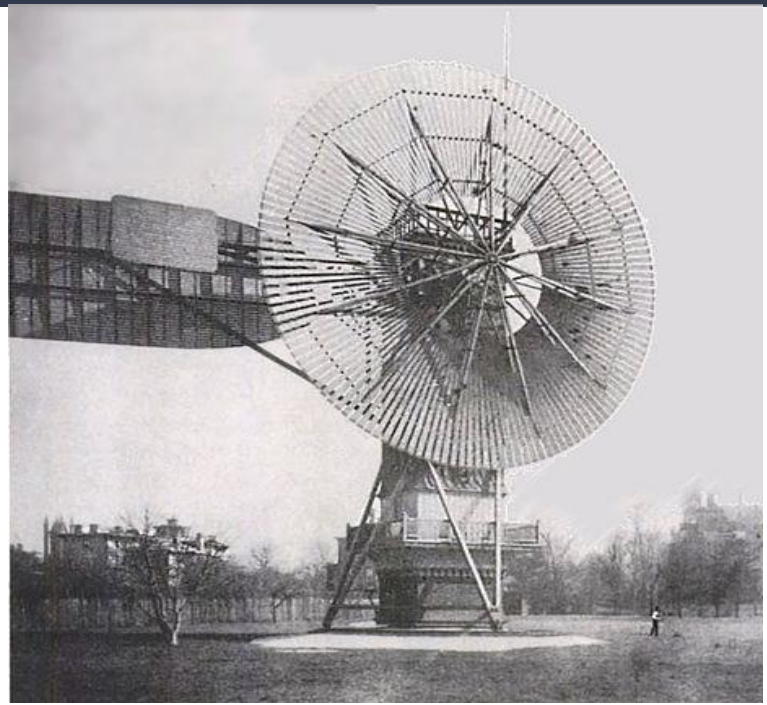
The wind energy sector has grown dramatically in recent years. According to the Global Wind Energy Council, global wind power capacity has more than quadrupled since 2007, and now generates more than 7% of the world's electricity. This growth is driven by a combination of factors, including technological advances, government policies, and falling costs.

History

The history of wind power can be traced back to ancient times when windmills were used to grind grain and pump water.

It was not until the 1970s that wind power became a serious contender as a source of electricity. This was due to the oil crisis of the 1970s.

The first modern wind turbine was built in the United States in 1975. It was a small machine with a capacity of just 30 kilowatts.

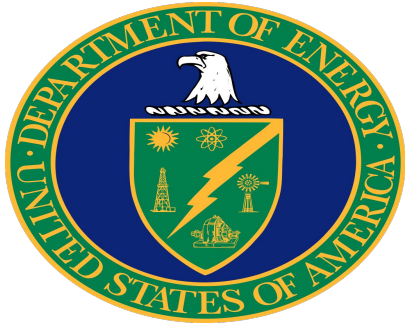


Government Policy

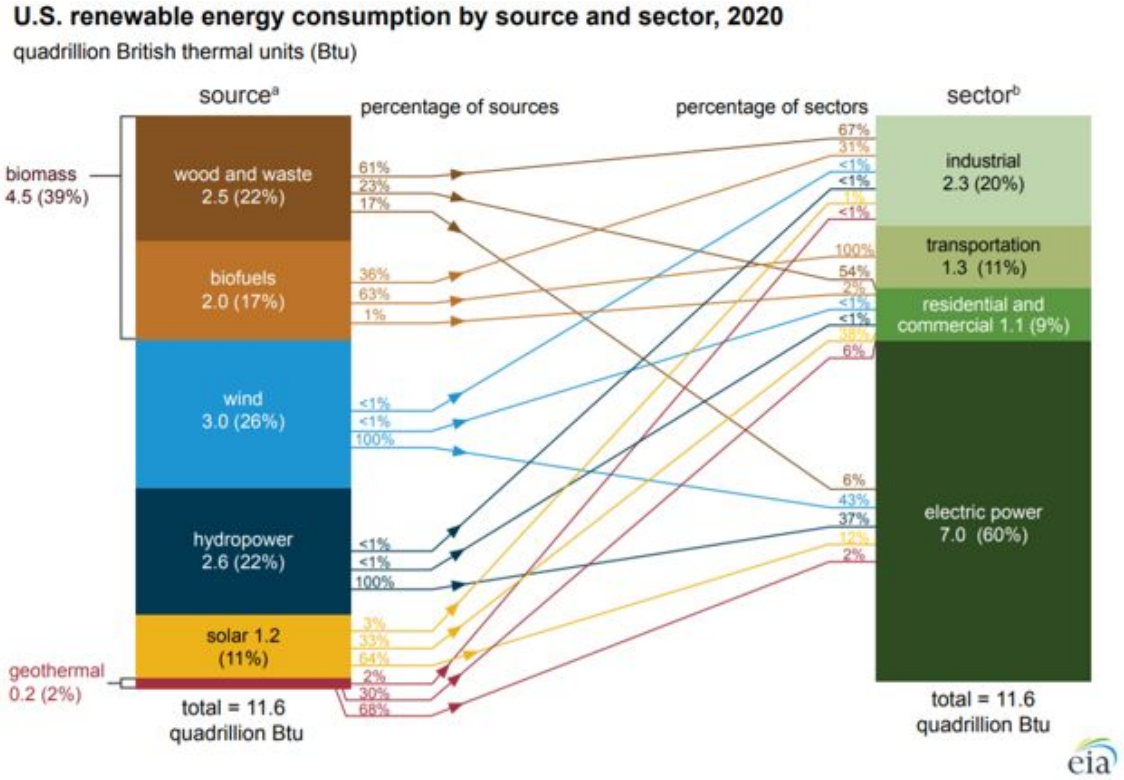
Tax incentives and renewable energy mandates, have played a significant role in the growth of wind power.

Denmark was one of the first countries to implement a feed-in tariff for wind power in the 1980s. This policy helped to spur the growth of wind power in Denmark and led to a reduction in the cost of wind power technology.

Other countries in Europe such as Germany, Spain, and Italy followed demarks lead.



Wind Industry



Chapter 31

The Fifth Fuel–Efficiency

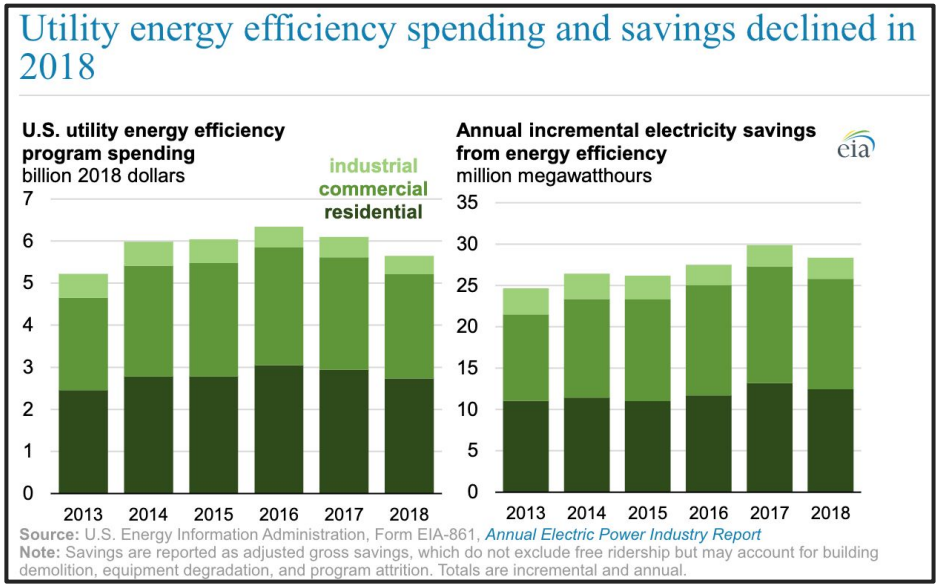
The “Fifth Fuel”: Efficiency

Efficiency traditionally thought of as a burden or cost

Two factors influenced the desire to increase efficiency: high energy costs and reducing stress on the environment

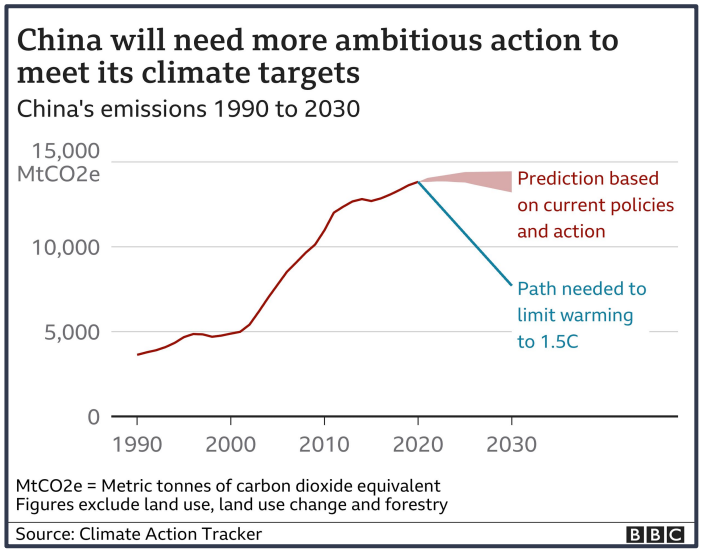
“The United States uses less than half as much energy for every unit of GDP as it did in the 1970s”

“A new car in the 1970s might have averaged 13.5 miles to every gallon. Today, on a fleet average basis, a new car is required to get 30 miles per gallon”



https://www.eia.gov/todayinenergy/detail.php?id=42975

Efficiency in China



https://www.bbc.com/news/world-asia-china-57483492

China was alarmed in 2004 by a calculation showing if they continued to consume oil at the same ratio as the US, by 2030 they would be consuming more than the entire global production

The 11th Five Year Plan (2006):

- Slogan “Jieneng Jianpai”--”Save Energy! Cut Emissions!”

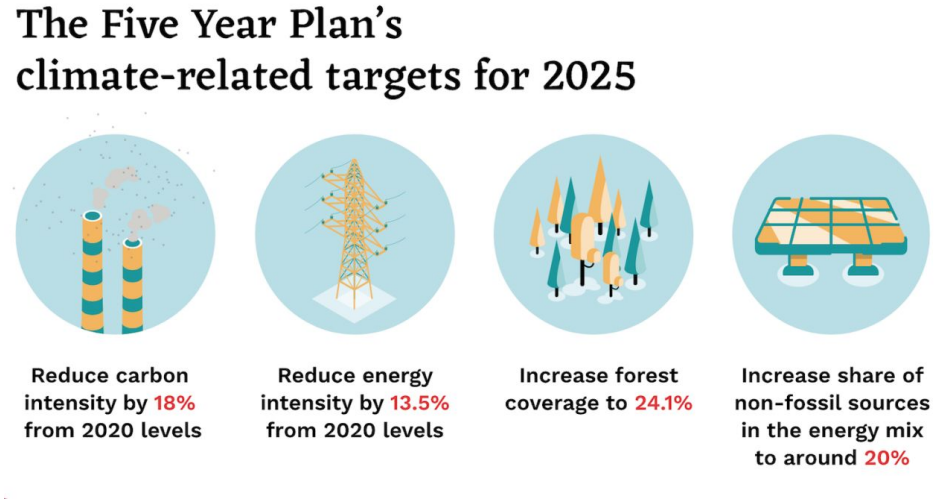
Keep economic development while reducing energy consumption

- Government “Iron-fist”
  - 2,000 energy inefficient steel mills, cement works, an other factories closed in China
  - Energy intensive industries no longer provided discounted electric power
  - Firms forced to shut down for part of the week to meet energy savings

Where is China Now?

The 14th 5 year plan is in effect (2021 - 2025):

- Energy & climate remain as central-policy priority
- For the first time omitted numerical GDP target
- Longer term climate goals
    - 18% reduction target for CO2 intensity and 13.5% reduction in energy intensity from 2021 to 2025



https://www.linkedin.com/pulse/china-co2-commitment-14th-five-years-plan-antonio-r-galvez

https://www.bsr.org/en/blog/china-climate-goals-the-14th-five-year-plan-sustainable-business-impact#:~:text=In%20the%2014th%20FYP%2C%20energy,on%20ecological%20and%20environmental%20protection.

Industry Efficiency

Part of global economy best organized to become more energy efficient

- In the US, accounts for ~⅓ energy usage

Technology has enabled processes to managed much more effectively

LED	CFL	Incandescent
Avg Life: 25,000 Hrs	Avg Life: 8,000 Hrs	Avg Life: 1,200 Hrs
No Mercury	Mercury	No Mercury
6-8 Watts	13-15 Watts	60 Watts
Uses 84% less energy	Uses 75% less energy	90% energy lost to heat

https://sustainability.wustl.edu/swap-your-conventional-light-bulbs-for-leds-at-no-charge/

Dow Chemical

Largest U.S.-based chemical company

$30 billion annual energy and feedstock costs

Equivalent of 1 million barrels of oil / day

Reduced its energy usage per pound of product by 25 percent (from 1995 to 2005)

- $9 billion in savings

CEO Andrew Liveris: “aspirational goal”

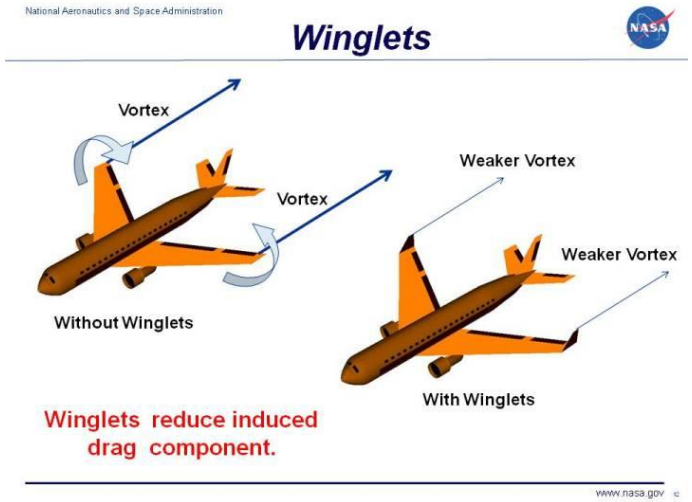
Andrew Liveris

The Airline Industry

- Fuel is number one cost: 25-35% of overall costs
- Volatility hurts the airlines very thin margins

https://www.smithsonianmag.com/air-space-magazine/how-things-work-winglets-2468375/#:~:text=Winglets%20produce%20an%20especially%20good,Several%20airliners%20use%20them.

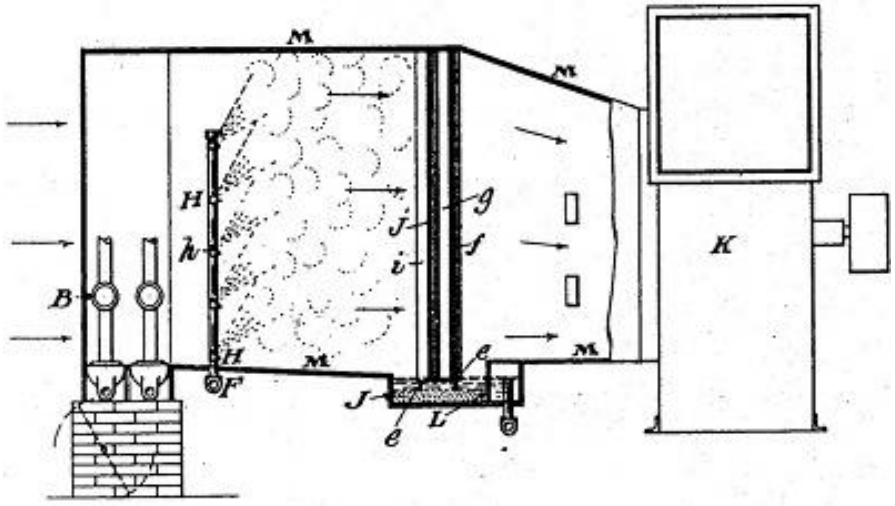
- Since the 1970s the fuel efficiency of jets has more than doubled
- Delta Airlines in 2012 bought an oil refinery near Philadelphia to produce jet fuel ($150 million cost)



Chapter 32

Closing the Conservation Gap

The Conservation Gap



Patent 808897 - “Apparatus for Treating Air”

The conservation gap is addressing the design, behavior, and difference between the potential efficiency and the reality

Challenge: how to construct liveable building while also using all of the energy that goes into them more efficiently

One of the nation’s worst heat waves occurred in 1901

- Hundreds of fatalities
- Willis Carrier
  - Developed solution to cooling and addressing humidity
  - Modern air conditioner

Gadgiwatts

The term “gadgiwatts” is used to describe more and more electricity consumed by gadgets that largely did not exist in the 1970s

1970s:

- 91% of household electricity: stoves, indoor lights, refrigerators, freezers water heaters, air conditioners, and space heating
- 9% “other”

Today:

- “Other” category accounts as 45% household usage

Green Buildings

U.S. Green Building Council and its LEED (Leadership in Energy and Environmental Design)

- Set of guidelines and certifications
- Energy & environmental goals

Current LEED Buildings at Penn State Include:

#	PSU LEED Buildings	Campus	Certification Level	Date of Certification
1	Child Care Center at Hort Woods	UP	Platinum	2014
2	Borland Building	UP	Gold	2009
3	Millennium Science Complex	UP	Gold	2013
4	Gaige Technology and Business Innovation Building	Berks	Gold	2012
5	Lions Gate Apartments	Abington	Gold	2018
6	Smeal College of Business Building	UP	Gold	2015
7	Stuckeman Family Building	UP	Gold	2007
8	Recreation Hall Addition	UP	Gold	2008
9	Student Health Services Building	UP	Silver	2010
10	Wilkes Barre Academic Commons	Wilkes Barre	Silver	2010

https://sustainability.psu.edu/campus-efforts/operations/green-buildings/

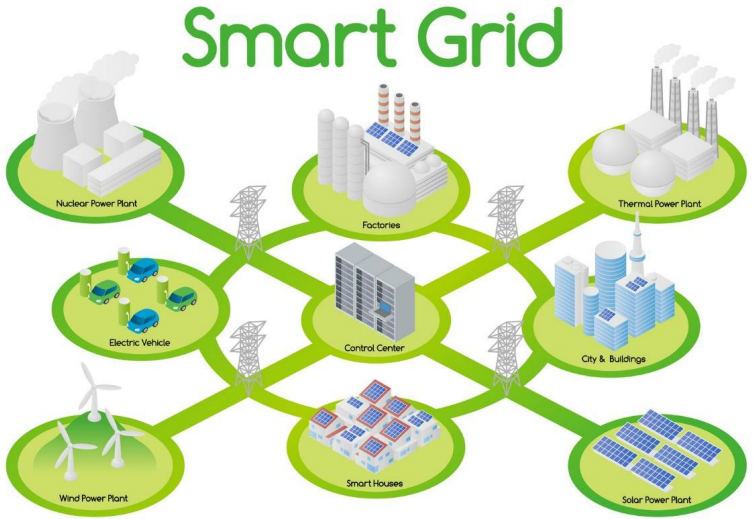
A Smarter Grid

Using technology to close conservation gap

The smart grid “...largely comes down to the application of digital technology, two-way communication, monitoring, sensors, information technology, and the internet.”

Providing only the amount of energy needed, saving energy and cutting down on CO2 emissions

Increase reliability & reducing outages



Chapter 33

Carbohydrate Man

Biofuels

Applying biology and biotech to the production of energy

In Brazil, 40-60% of automotive fuel is already ethanol

Flex vehicles run off E85 (85% EtOH)

- Model T could run on either ethanol or gasoline when introduced
- Prohibition in 1919 stopped alcohol fuels

https://www.sciencedirect.com/science/article/abs/pii/S0263876218300182

Ethanol Beginnings

https://www.loc.gov/item/2021637306/

Oil shocks of 1970s hit farmers hard

1979 “tractorcade”

- Farmers wanted a national commitment to ethanol
- 10,000 gasoline stations sold ethanol in 1981

Ethanol Boom

- Energy Policy Act of 2005
  - Banned methyl teriary butyl ether, ethanol's major competitor
  - Established Renewable Fuel Standard
    - 500,000 barrels of EtOH/day in motor fuel by 2012

- Food vs. Fuel
  - Only about 1% of corn crop is eaten directly by humans as corn

Biofuel From Algae

Algae absorbs sunlight and CO2, and produces oxygen and bio-oils

- Oils are very suitable for production of gasoline and diesel

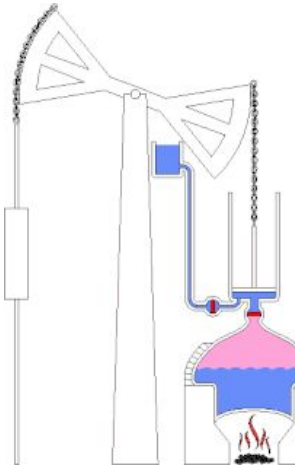
Challenge is maintaining the stability of the algae population at commercial scale

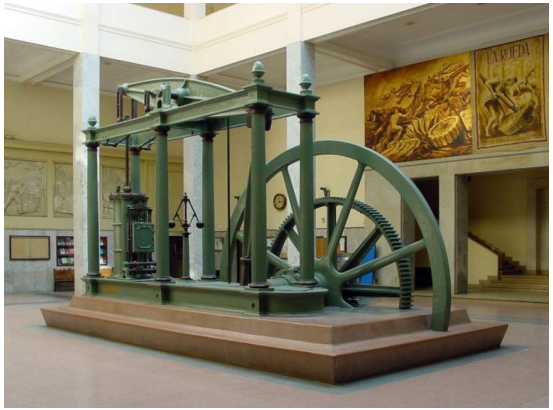
Chapter 34

The Birth of Engines
The Rise of the Automobile

Age of Steam

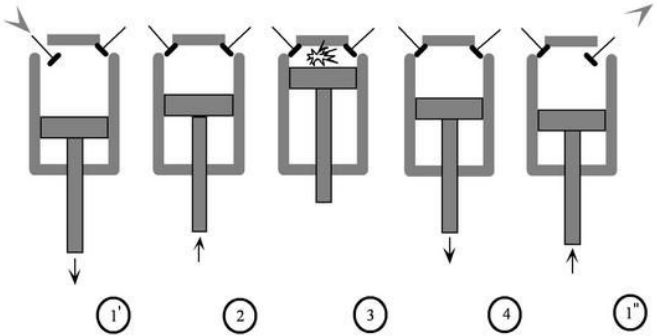
- Thomas Newcomen, English inventor, creates first steam engine in 1712, used for pumping water out of coal mines
- Improved design and efficiency leads to Age of Steam
- Steam powered artillery?
- Fueled the Industrial Revolution





Herr Otto’s Great Discovery

- Nikolaus Otto’s obsession with heat engine, but severely debted
- Investor Eugene Langen allows him to create a much more efficient design, and partners with Otto
- Wins gold medal at 1867 Paris Exposition
- Expansion leads to dissension
- Shatters the insurmountable 3 horsepower barrier
- Paves the way for modern internal combustion engine (ICE)



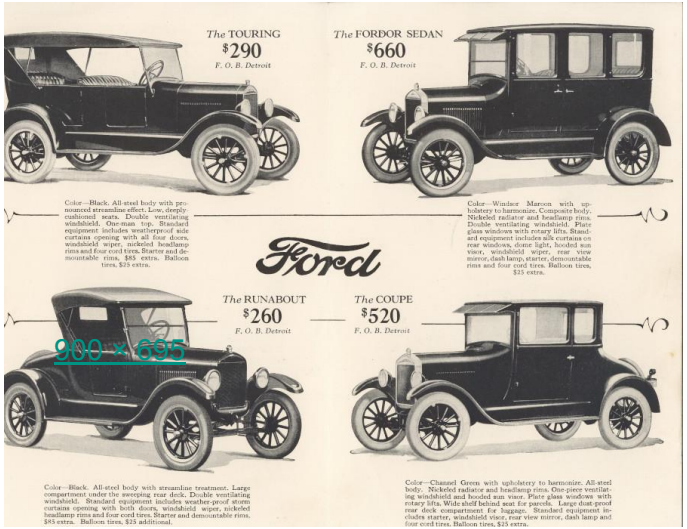
Nikolaus Otto

Origins of Electric Versus Gasoline Cars

- Red Flag Act
- Edison Illuminating Convention of August 1896 has namesake as guest of honor
- Henry Ford, chief engineer at EIC of Detroit, doodles ideas of a car powered by combustion of hydrocarbons to Edison
- Edison, Father of Electricity, proclaimed gasoline cars was the “thing”, with an ardent slammed fist
- No faith in gas powered cars at the time, first transportation/fuel race
- Edison recognized concerns with E.V. batteries at the time
- Ford takes Edison’s blessing and works twice as hard on his ideas
- Gasoline would be king within next decade

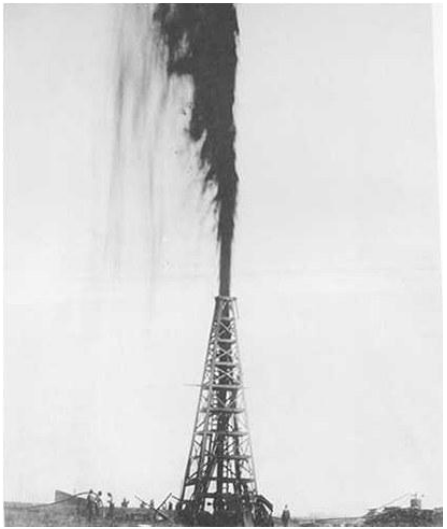
Henry Ford's Model T

- Debuts Model T for $825 excluding extras ($26,000 adjusted)
- Assembly Line production
- Half of global car fleet in 1920



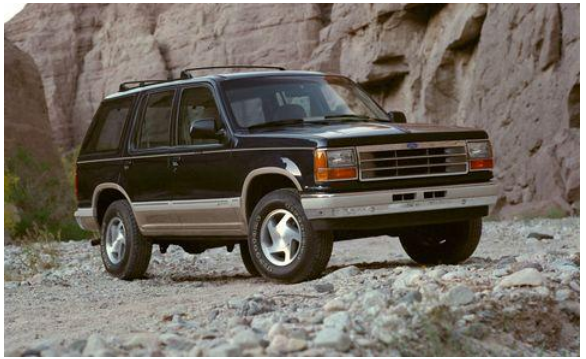
The Savior of Oil

- Industry reliant on kerosene for first 40 years
- Spindletop changes outlook on petroleum as fuel
- First gas station opens in St. Louis in 1907
- 1911, gasoline overtakes kerosene in sales
- Hundreds of thousands of gas stations in the U.S. by 1920s



New Regulations on Fuel Efficiency

- 1973 oil crisis brought fuel efficiency to forefront of debate
- Big Three (GM, Chrysler, Ford) vehemently opposed fuel efficiency regulations, cited free market
- Corporate Average Fuel Efficiency Standards in 1975
- 13.5 mpg to 27.5 mpg
- Taxes or regulations?
- The “light truck” loophole
- Mid 90s dubbed the Golden Age of American Autos



1990 Ford Explorer

1987 Chrysler Minivan

1990 Chevy Blazer

Competition from the East

- Toyopet S30 fails with L.A/S.F. markets in 1950s
- Japanese automakers saw U.S. market for small cars open because of Oil Crisis of 1973
- Detroit affixed with larger vehicles
- No legacy costs allowed for more profit
- Japan/Korea began vertically integrating in the U.S., to combat xenophobia
- S.U.V. craze ends around 2004, mainly a result of spiking fuel prices
- Nightmare for Detroit, with no contingency plan
- $100 a barrel in 2007 leads to new fuel efficiency regulations
- Energy Security and Independence Act of 2007 symbolically delivered to President Bush in Toyota Prius

Michigan Central Station (1950)

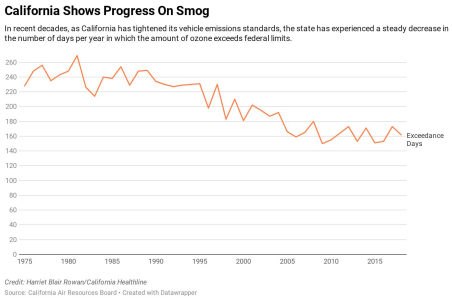
Michigan Central Station (2008)

Chapter 35

The Modern Transportation Race

Paralyzing Smog

- Arie Hagen-Smith discovers cause of smog in 1948, deemed Father of Smog
- Reignited effort to bring back tailpipe-less cars (E.V.s)
- California's geography makes smog much worse
- Smog attack in October 1954 shut down Los Angeles
- Governor Reagan creates California Air Resource Board (CARB) in 1967
- CARB gains national influence as California becomes more important to the Union



California is King

- California becomes first state to regulate its own emissions
- Congress allowed states to choose between federal or CARB regulations for emissions
- “CARB punches above its weight”, becomes judge and jury for auto industry
- Catalytic Convertor virtually eliminates smog, dropping 99% from 1970s levels by the end of the 90s
- In 1990, CARB pushes for zero emissions vehicles (ZEV), ordering that 10% of all cars in the state would be ZEV by 2003
- Lack of battery technology caused CARB to back away in court
- GM’s EV1, “Who Killed the Electric Car?”

CALIFORNIA AIR RESOURCES BOARD

CALIFORNIA AIR RESOURCES BOARD | CARB

Renewing the Electric-Gasoline Debate

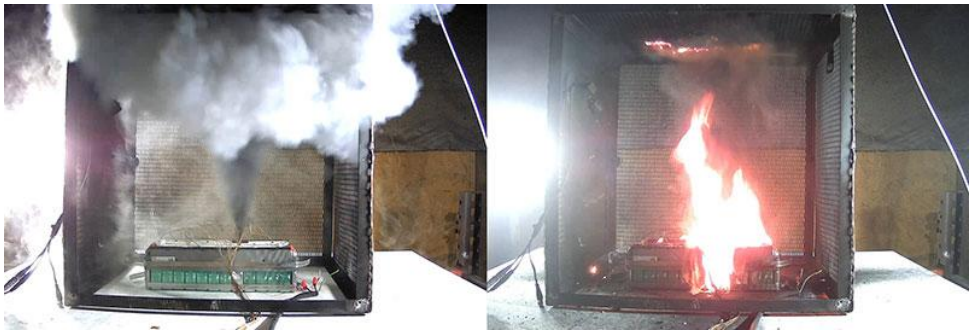
- E.V.S versus P.H.E.V's
- P.H.E.V Chevy Volt heavily endorsed by McCain and Obama before 2008 Election
- Shifts debate from biofuels to batteries as competitor for oil
- Bailouts of Chrysler/GM in Dec. 2008 allow Obama Administration to push electric car agenda
- CARB reissues order for ZEV's in California, albeit with a smaller initial target for 2012
- Research on lithium ion batteries during 1970s proves valuable to laptop/cell phone boom in 1990s
- Lithium batteries were lighter and could store more energy

Tesla Roadster: The E.V. Pioneer

- Al Cocconi, an engineer on the EV1 project, encounters 2 Si. Valley investors, including Elon Musk
- Cocconi has an E.V. prototype called the Tzero, that can go 0-60 in 4.1s
- With funding, Cocconi is able to improve his designs into a “iconic electric sports car”, the Tesla Roadster
- 2 seater, expensive ($150,000 adjusted for inflation), but served as stepping stone for affordable E.V.’s
- Required 7000 laptop batteries, and constant challenges arose
- Tesla gains its foothold, making its IPO in June 2010, first in 64 years since Ford
- Roadster proved E.V.’s were not XL golf carts, but green super cars

Concerns with an Electric Car Market

- Infrastructure
- Battery Storage/Thermal Runway
- Range Anxiety and other customer prenotions
- Impacts on local power grids
- E.E.V's. (Emissions Elsewhere Vehicles)
- Politics



Looking into the Future

- The midst of a new transportation and fuel race
- At least another 2 decades of oil dominance
- Competitors to oil are E.V's./P.H.E.V's, biofuels, NGV's (Natural Gas Vehicles), ICE engines with increasing efficiency, fuel cells
- E.V's/P.H.E.V's likely leading, as projections land at 14% of car fleet in U.S. by 2030
- Asia first
- Criteria of victory
    - Delivery of increasing efficiency cars that meet tests of environment, energy, security, costs, performance
- Winner is still unclear, but will have immense power at a global scale

Questions?